The American Midland Naturalist

Devoted to Natural History,

Primarily that of the Prairie States

VOL. XIII.---1932

UNIVERSITY OF NOTRE DAME
NOTRE DAME, INDIANA

CONTENTS

CONTENTS

ERRATA

p. 91, l.10: read "officinale."

p. 105, l.29: read "Prunus."

p. 262, l.33: read "Bairdia pennata" for "Bairdia angulata."

p. 404, l.22: read "Bairdia."

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Vol. XIII. JANUARY, 1932 No. 1.

The American Midland Naturalist

Devoted to Natural History, Primarily that of the Prairie States

Published by the University of Notre Dame, Notre Dame, Indiana

PRICE, $1.50 A YEAR SINGLE NUMBERS, 30 CENTS FOREIGN, 6s, 6d.

Entered as second-class matter at Notre Dame, Ind. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3. 1917, authorized on July 3, 1918.

THE UNIVERSITY PRESS, NOTRE DAME, INDIANA

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Vol. II, nos. 1, 2, 8.
Vol. III, nos. 1, 2, 3, 7, 9.
Vol. IV, nos. 1, 2, 4, 5, 6, 7, 8.
Vol. VI, index, title page.
Vol. X, index, title page.
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The American Midland Naturalist

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NOTRE DAME, INDIANA.

VOL. XIII. JANUARY, 1932 No. 1.

A NEW JURASSIC AMMONITE FROM THE COAST RANGES OF CALIFORNIA

C. H. CRICKMAY

Recent geological field work by Professor N. L. Taliferro at Nipomo, in the Coast Ranges of Middle California, has unearthed an immensely interesting find: a late Jurassic marine fauna in the Franciscan Series. The specimens have been entrusted to me by their discoverer for paleontological investigation. Among them, there are some belonging to a large ammonite of the family *Berriasellidae* which do not accord with any named species or genus. It, therefore, seems desirable to describe and name them. Certainly, the species is important, because it marks a Tithonian date in a region from which no Tithonian deposits have been demonstrated. It is important further, because, as a Franciscan fossil, and as a marker of latest Jurassic time, it may help to solve some of the puzzles of Californian geology, and of the history of the late Jurassic in general.

The description of the newly discovered fossil follows:

Phylum	MOLLUSCA
Class	CEPHALOPODA
Order	AMMONOIDEA
Family	BERRIASELLIDAE
Genus	**Protothurmannia** gen. nov.

The youngest whorls are perisphinctoid. These are succeeded by a *Berriasella*-stage in which the costae are slightly

flexed, divided on the flank, and interrupted on the venter. With maturity, the costae become flexuous, and finally, very massive, with nodes on their umbilical ends. They lose the ventral interruption. Whorls, compressed. Umbilicus, wide. Septal line, elaborate; lobes, long; auxiliaries, strongly dependent. EL<LI = Aux.

The genus differs from other Berriasellids in three respects:

1. Loss before maturity of the ventral interruption of costae.
2. Attainment of coarse tuberculation round the umbilicus.
3. Development by the septal line of high elaboration, exceptionally long lobes and strongly dependent auxiliaries.

These are specialized characters, yet they come at a time before any other Berriasellids show an equal advance. However this form is to be connected with *Berriasellidae* by its adolescent *Berriasella* ornament and septal line.

Genotype. — **Protothurmannia rezanoffiana** Crickmay sp. nov.

Name.—An early group, of Thurmannites (="*Thurmannia*") aspect.

Protothurmannia rezanoffiana sp. nov.

PLATES I AND II.

Description.—The *Berriasella*-stage is passed earlier in some specimens than in others, the average being at 55 mm. diameter. Secondary costae arise as bifurcations of primaries, or are freely intercalated. A quadrant of whorl contains:

At 72 mm. diam. 13 primaries, 27 secondaries;

At 125 mm. diam. 19 primaries, 32 secondaries, 7 umbilical knobs.

At 57 mm. most of the primaries become linked in pairs at their umbilical ends. The ribs become flexuous. At 70 mm. nodes are developed on the umbilical linkings of costae. With age, costae and nodes become very coarse. A few constrictions are to be seen at various stages, even on the young whorls, and especially between 6 mm. and 18 mm. diam. where the holotype has about 5 to a whorl. Sides, slightly convergent.

Dimensions:

	Holotype	Paratype 1	Paratype 2
Diameter	92 mm.	67? mm.	350? mm.
" 180° back	53		
Thickness	—	20	80
" 130° back	17		
" 180° back	14?		
" 360° back	9?		
Width of umbilicus	33		
" 180° back	18		
" 360° back	11		
Height of whorl from umbilical edge	37	29	
" 180° back	23		

Paratype No. 2 is the largest specimen seen.

Locality.—Headwaters of Alamos Creek, a tributary of Cuyama River, southern San Luis Obispo County, California.

Formation.—uppermost Franciscan.

Age.—Late Upper Jurassic, Berriasellidan.

Name.—After Count Nikolai Petrovich Rezanoff, 1764-1807, plenipotentiary of the Russian-American Company, the "Concha's Lover" of Bret Harte's poem.[1]

Collector.—Professor N. L. Taliferro, University of California.

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[1] Brete Harte: Concepcion de Arguello. Atlantic Monthly, vol. 29, Boston, 1872.

Remarks.—This new species is associated with

Berriasella cf. *calisto d'Orbigny*
Substeueroceras sp.
"Crioceras" sp.
"Bochianites" sp.
"Phylloceras" sp.
"Lytoceras" sp.
Pachyteuthis sp.
Buchia terebratuloides Lahusen,

which occur in a buff-colored, hard, massive, calcareous shale, at the type locality in San Luis Obispo County.

Protothurmannia rezanoffiana belongs to a fauna which has been reported from the Sierra Ramirez and elsewhere in Mexico.[2] In that country, it includes undescribed species of *Berriasella*, *Substeueroceras*, *"Crioceras,"* etc. apparently identical with the forms at Nipomo. The presence of the characteristic Berriasellids shows that the fauna is contemporaneous with those of the Upper Tithonian of Central Europe, the lower Berriasian of southern Europe, the Rjasan beds of Russia, the Lochambel beds (pars) of the Spiti shales of the Himalaya, and deposits of like age in South America and New Zealand.

The local equivalents of this fauna are somewhat obscure, but have yielded themselves, in some measure, to a special search which I made for them. Certainly, the "Portlandian" and "Aquilonian" *"Aucellae"* which Pavlov[3] described from the "Knoxville beds" (= "Knoxville shales") of the northern Coast Ranges are of the same *age* as this fauna, though not necessarily of exactly the same *date*. These have no connection with the *Buchia pioch'i* and *B. crassicollis* faunas of the

[2] C.Burckhardt: Faunas Jurasicas de Symon (Zacatecas). Instituto Geologico de Mexico, Boletin 33, 1921.

[3] A. P. Pavlov: Enchaînement des Aucelles et Aucellines du Crétacé russe. Société impériale des naturalistes de Moscou, nouv. mém., tome 17, 1907.

Knoxville sandstones which are of early Cretaceous age, —Subscraspeditan to Hoplitidan.[4]

There is also an equivalent in the Sierra Nevada, long known, but never correctly recognized. *"Aucella erringtoni* var. *arcuata"* Hyatt 1894 is no relation to the Kimmeridgian *Buchia erringtoni* Gabb, but is an independent species, perhaps related to such forms as *terebratuloides, andersoni,* etc. It is to be called *Buchia arcuata.* Its relationships, and its association with fragments of Tithonian ammonites, show it to be of Tithonian age. The unknown formation in which it occurs, a green-grey shale and sandstone,[5] is very different from, and much younger than, other Upper Jurassic formations in the Sierra Nevada, such as the Mariposa slate.

A number of important problems arise from Professor Taliferro's interesting find, and from my discoveries which resulted from his. In the first place, another station now extends from the range of the almost universal *Berriasella* fauna. Another station now records the mixing of Berriasellids — *Berriasella* and *Substeueroceras* — and genuine[6] Tithonian *Buchiae* (="*Aucellae*") of Russian origin, e. g., *B. terebratuloides* Lahusen, etc.

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[4] *Buchia piochii* has been renamed *B. gabbi* by Pavlov who supposed the name *piochii* to be invalid because it was confused by its author, Gabb. But this is insufficient reason; hence *piochii* stands, and *gabbi* falls into its synonymy. Pavlov did a good service, however, in calling attention to the pre-Cretaceous *Buchiae* (or "*Aucellae*"), *B. Stantoni,* etc., which had long been identified with the Cretaceous species.

B. crassicollis has been much misidentified in California, where it is comparatively rare. It is much commoner in British Columbia. The species in California which commonly pass for *crassicollis* are *B. crassa,* and related forms.

[5] This is the matrix of the type specimens from Tuolumne River in U. S. National Museum.

[6] "*Aucellae*" from more southerly localities, *e. g.* India, and New Zealand, are very different, and hardly congeneric.

This faunal geography can mean only wide marine connections in the latest Jurassic, especially between west America and Russia by way of the Arctic, and between the Pacific and western Europe, probably through Central America. Similarly, it means wide continuity of physical conditions, presumably including climate. This requires a considerable modification of existing opinion; and, on that account, it is unedsirable to attempt to interpret this faunal geography in terms of paleoclimatology without more data.

In the second place, the occurrence of beds of Tithonian age at several places in California has a vast importance to local geology. Formerly, no Jurassic deposits younger than Kimmeridgian were known in California. But the discovery of these Tithonian beds introduces a younger element. It is important that these are the latest of Jurassic deposits, that is, later than Portlandian and Aquilonian neither of which has been found in California.[7]

The structural relations of these latest Jurassic deposits of California are very important, and little known. The relations of the *Protothurmannia* beds to the earlier Jurassic at Nipomo, of the *Buchia arcuata* beds to the Mariposa, of each of the Tithonian deposits to the great batholiths, are still unsolved problems. The answers to these questions are solutions of certain fundamental problems of the Nevadian orogeny: the nature and timing of the diastrophism, and of the intrusion. On the other hand, the relations between these Tithonian deposits and younger formations which have never been made clear before, though the change in lithology from "Knoxville" *shale* to Knoxville *sandstone* may be significant of diastrophism, now become less obscure. The relations at Nipomo are evident, and they shed clear light on the whole prob-

[7] True Portlandian formations are very rare; and the Aquilonian, or *Craspedites* beds, are known only in Russia, and are not yet satisfactorily correlated with the standard Jurassic chronology. They are post-Kimmeridgian pre-Tithonian, yet there is no positive evidence on which to correlate them with the Portlandian.

lem. The very early Cretaceous sandstone with *Buchii piochii* lies unconformably on the very late Jurassic *Protothurmannia* beds. The mere existence of these late Jurassic shales with *Protothurmannia* proves a long persistence of the Jurassic seas in this region. The fine grain of the deposits, and their marked contrast in this respect to the basal Cretaceous, seems to indicate diastrophic calm during late Jurassic time. But, the unconformity, and the coarse beds which succeed it, are clear evidence of mountain-making. This conclusion narrows the Nevadian Orogeny to a single mountain-building at the very end of the Jurassic Period. However, the study of one locality does not completely solve a problem of this sort. Hence it will be interesting, as future work is done, to see whether the geological testimony of certain other localities, notably those of the Sierra Nevada, confirms or contradicts these conclusions.

University of Illinois.

PLATE I.

Fig. 1. *Protothurmannia rezanoffiana* Crickmay, n. sp., holotype, x 1. Cross-section of whorl at diam. 60 mm. The outer line is on the rib; the inner, between ribs.

Fig. 2. *P. rezanoffiana* Crickmay, paratype No. 1, a fragment of a whorl the diameter of which would be 80 mm., slightly less than natural size, ventral aspect. Shows the disappearance of the ventral interruption of ribs.

Fig. 3. *P. rezanoffiana* Crickmay, paratype No. 1, slightly less than natural size, lateral aspect. Shows the first appearance of knobs on umbilical edge.

Fig. 4. *P. rezanoffiana* Crickmay, paratype No. 1, slightly less than natural size, cross-sectional aspect. The outlines are on the rib, and between ribs.

Fig. 5. *P. rezanoffiana* Crickmay, paratype No. 2, slightly less than natural size, lateral espect. This fragment of a large specimen (diam. about 350 mm.) shows L1, L2, and dependent auxiliaries. The massive, blunt ribs appear less clear and less prominent than they should be.

PLATE I.

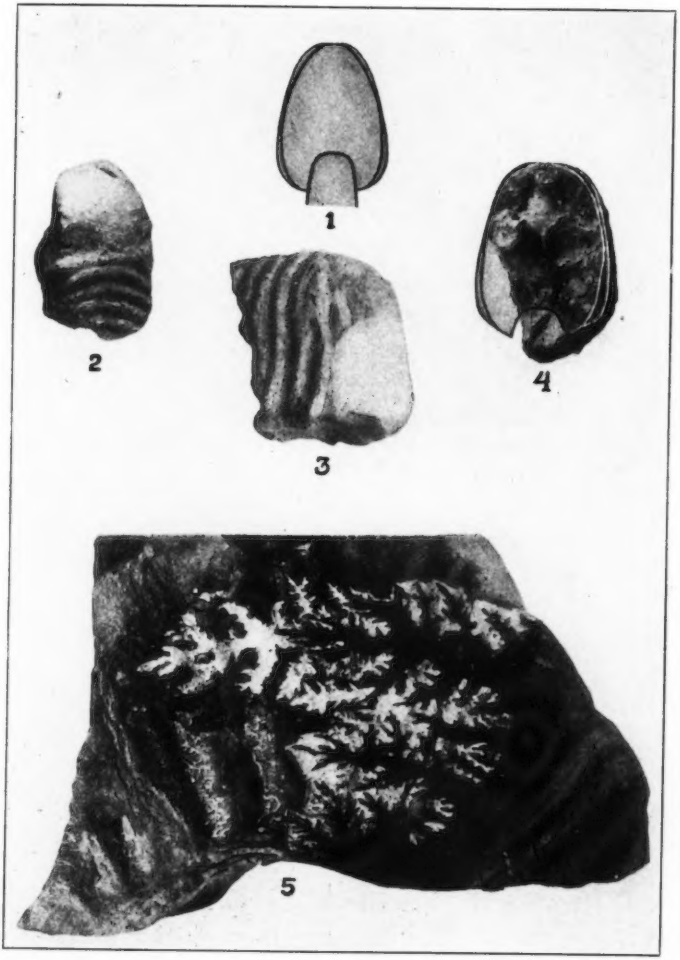
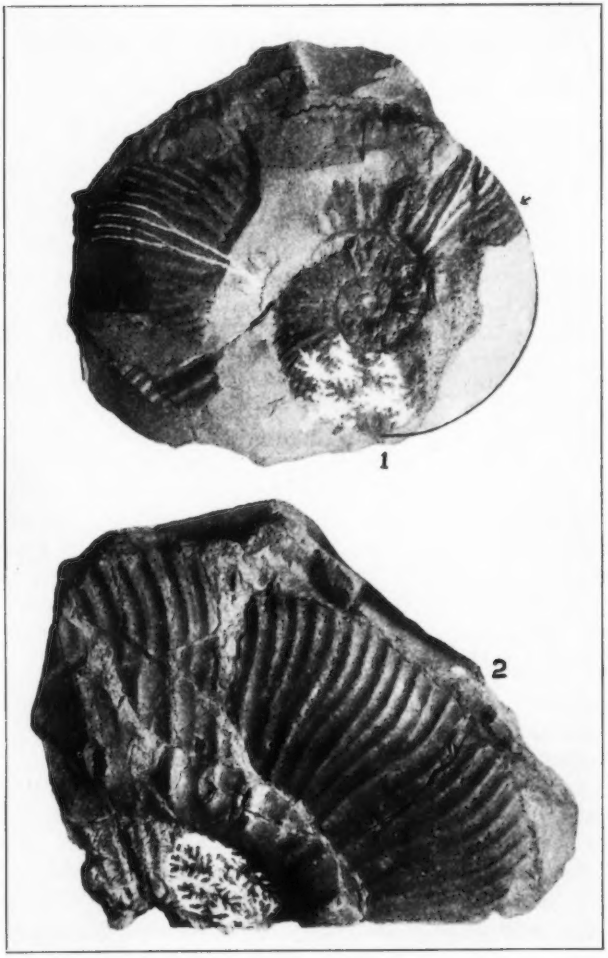


PLATE II.

Fig. 1. *P. rezanoffiana* Crickmay, n. sp., holotype, somewhat less than natural size, lateral aspect. Shows ribbing, and septal line. Arrow indicates position of last septum. Dotted line shows dislocation of a part of the last whorl. The part showing the ribbing is dislocated less, and in a different manner.

Fig. 2. *P. rezanoffiana* Crickmay, paratype No. 3, slightly less than natural size, lateral aspect. The ribbing, including umbilical knobs, at diam. about 90 mm. is well shown.

PLATE II.



A PROBABLE SECOND RECORD OF THE EXTINCT DEER, ODOCOILEUS DOLICHOPSIS (COPE)*

WILLIAM L. ENGELS

The Pleistocene deer, *Odocoileus dolichopsis* (Cope), is known only through the type specimen, a left mandible found by John Collett, formerly the Indiana State Geologist, in a late lacustrine deposit in southern Indiana, probably in Vanderburg County.[1] This specimen was described, and the species established, by Professor Cope in 1878. A second description, embracing results of "additional observations and comparisons," was given by Cope and Wortman in 1884.

The next, and only other, discussion of this species was made by the late O. P. Hay, in 1912. Hay accepted the species as valid; it is worth noting, however, that he seems not to have seen the actual specimen, his remarks and opinions being drawn entirely from a critical analysis of Cope's descriptions and Cope's illustrations. One can but conjecture as to the probable fate of the type; since Prof. Cope's second description (1884) was dated as from Philadelphia the specimen may be somewhere among the palaeontological collections of the Philadelphia Academy of Sciences, though inquiries directed there have elicited no information.

The lost mandible, which was not only the type, but the sole record of the species, was that of a deer, differing in its proportions from the jaws of the Virginia deer, the mule deer, and the black-tailed deer. "It belonged to an animal of the average size of *C* [*ariacus*] *virginianus*, but differs in

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* Presented at the Forty-Seventh Annual Meeting of the Indiana Academy of Science, Butler University, Indianapolis, Dec. 4, 1931.

[1] In the original description (Cope, 1878a) the locality was given as Vanderburg county. In the redescription, Cope and Wortman (1884) stated that it came from Harrison county; Hay (1923) is of the opinion that it probably came from Vanderburg county as originally stated.

having the diastema an inch or so longer, while the tooth line is shorter. Placing the first molars in line, *the last molar of the fossil form attains only the penultimate column*[2] of that of the *C* [*ariacus*] *virginianus;* in some cases just a little further." (Cope and Wortman, 1884.) Further differences were said to lie in the greater length of the mandible due to an increased posterior development of the angle, the more gradual slope of the anterior base of the coronoid, and the great prominence and anterior position of the posterior border of the masseteric fossa. Hay (1912) concludes that "this deer had, in proportion to the length of the series of cheek teeth, a considerably longer lower jaw and doubtless a larger head; more especially a longer nose [than the Virginia deer]".

The specimen herein to be considered a second record of *O. dolichopsis* comes from the same general locality as the type; it is from Harrison county, Indiana, having been found by Dr. M. W. Lyon, Jr. in a limestone cliff cave, at Tobacco Landing, beside the nest of a wood rat. It consists of a portion of the left mandible, approximately two and one-half inches long and three-fourths of an inch deep, with the lower edge broken away, but bearing the last premolar and all of the molar teeth; it is somewhat discolored. The lingual surface shows evidence of having been gnawed by some rodent which was smaller than the wood-rats among whose characteristic rubbish it was found. The teeth are well-worn, and are evidently those of a very old animal. They agree almost perfectly in appearance with the illustration of the type; the measurements very nearly approximate those given by Cope for the original specimen of *O. dolichopsis.* I have compared it with mandibles of a number of Virginia deer, principally Michigan specimens; in every case when the molars are lined up the last molar of this specimen reaches but to the penultimate column of that of the Virginia deer, despite which shortness in length the molars are distinctly wider. There is no doubt but that it differs sharply from the Virginia deer; in-

[2] Italics by this author.

asmuch as the diastema and the anterior dentition as well as the ascending ramus and angle are missing, it is principally upon the short length of the molar series and the greater width of the molars that I refer it to *Odocoileus dolichopsis* (Cope).

Measurements[3] of the teeth follow:

	Length of Crown	Width of Crown	Height of Crown	Length of Molar series
Pm_4	11.7	9.4	6	48.5
M_1	13.7	10.6	3	
M_2	15.7	11.6	5	
M_3	20.5	11.4	6	

University of Notre Dame.

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———— 1878. Descriptions of New Extinct Vertebrata from Upper Tertiary and Dakota Formations. Bull. U. S. Geol. Surv. Territories, iv, p. 379. (*Cariacus dolichopsis*).

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———— 1923. Pleistocene of North America and Its Vertebrated Animals from the States East of the Mississippi. . . Publ. Carnegie Inst. Wash. no. 322, pp. 228, 258, 334.

[3] All measurements are in millimeters. Length—greatest antero-posterior diameter measured on worn surface of crown; width—greatest transverse diameter measured at base of crown; length—greatest height of enamel measured on lingual surface. Measurements of length and width were made with vernier caliper.

PLATE III.

Tobacco Landing, Harrison county (Indiana) specimen of *Odocoileus dolichopsis* (Cope) with left mandible of *O. virginianus* (from Wisconsin) to show difference in length of molar series. The first true molars of each are placed in line.

FRANKLIN'S GROUND SQUIRREL AND ITS DISTRIBUTION IN INDIANA *

MARCUS WARD LYON, JR.

Franklin's Ground Squirrel, *Citellus franklinii* (Sabine) 1822, is a relatively large animal nearly equalling the Gray Squirrel in size and somewhat resembling it in color. Its tail is less bushy and shorter. The upper parts are dull brownish gray, with head and neck slightly darker; hands and feet gray; underparts grayish to buffy. The colors are so arranged on the upperparts as to make small obscure light and dark spots. Tail, gray and for a ground squirrel, very bushy. Total length, 15 inches (375 mm.); tail, 5 inches (125 mm.); hindfoot, 2 inches (50-55 mm.); weight 12 oz. (370 grams).

Franklin's Ground Squirrel is the book name of the animal. Locally it is called Prairie Squirrel or Gray Gopher. The technical name was given by Sabine in 1822 in honor of the ill-fated explorer, Sir John Franklin, on one of whose expeditions the species was discovered in what is now Saskatchewan. It is found throughout the central United States and Canada from Oklahoma and north-western Indiana to the Athabasca River.

Franklin's Ground Squirrel is strictly terrestrial and so confined, at least originally, in Indiana to the prairie portion of the state. The original prairie area includes portions of Lake, Porter, Laporte, St. Joseph, Newton, Jasper, Starke, Pulaski, White, Tippecanoe, Warren and Vermillion Counties, and all of Benton County. With the clearing off of the timber and rendering much of the state an artificial prairie it has slowly spread a few miles to the eastward. It is found in fields and meadows where its burrows are made, very similar to, but distinctly larger than those of the common Thirteen-

* Presented at Forty-Seventh Annual Meeting of the Indiana Academy of Science, Butler University, Indianapolis, Dec. 4, 1931.

lined Ground Squirrel. There is often more than one opening to a burrow. Frequently the dirt is scattered away from the opening so that no mound about it exists.

The food of Franklin's Ground Squirrel consists of grain, wild seeds, fruits, green vegetation, and a variety of insects such as grasshoppers, crickets, beetles, and cutworms. It also eats birds' eggs, young birds, and young mice, and has even been known to kill and eat a young rabbit.[2] For a detailed list of material found in stomachs see Bailey[3] page 57. His summary shows animal matter 30.3 per cent; vegetable 68.5 per cent and indeterminable matter 1.2 per cent.

Franklin's Ground Squirrel is active from about the first of April until the first of November. At the latter time it betakes to its nest in its burrow and passes the winter in a state of hibernation. Mating takes place soon after waking from the winter sleep and young numbering up to half a dozen are born before June. Only one litter is produced in a season. The animals are said to be easily tamed and to make interesting pets. "Their voice is much like that of the thirteen-lined ground squirrel, but is as much heavier as they are larger. It is often heard in a long babbling trill from a weed patch and is almost birdlike in musical quality."[4]

Franklin's Ground Squirrels are comparatively rare in Indiana. In making inquiries about them in counties where they are known to occur it is often difficult to find persons who are familiar with them. No one has complained of damage done by them though at corn-planting time they are accused of eating the seed, but these same farmers have never been able to point out one of the animals or to show their burrows to me. They are easily caught in small steel traps set in the entrances to their burrows. These ground squirrels are good swimmers. I tried to drown one taken in a No. 1 steel trap and the animal was not only able to keep itself afloat but to make progress through the water in spite of its handicap.

Following is a chronologic list of records of occurrence and specimens taken in Indiana, and some new observations on distribution.

The earliest record for the state which I have found is by Dinwiddie,[5] pages 150-157, for Lake County in 1884.

Bailey,[3] 1893, page 49, reports its occurrence at Earl Park, Benton County, and Kentland, Newton County.

Evermann and Butler,[6] 1894, page 129, report its occurrence at Remington, Jasper County; Monticello, White County.

Hahn,[7] 1909, page 478, records it from Mt. Ayr, Newton County, where he took three specimens presumably now in the U. S. National Museum, and Hebron, Porter County. He also says, page 479, "Mr. W. S. Blatchley reports digging one of these spermophiles out of a mound near Boone Grove, Porter County, on October 6. At that time it had already begun to hibernate." Dr. Blatchley informs me that this specimen is now in his private collection.

Lyon,[8] 1924, page 285, reported its occurrence at Walkerton, St. Joseph County, and sent one specimen to the National Museum and another to the National Zoological Park.

During the past two years I have taken specimens of or seen or heard of Franklin's Ground Squirrel at the following places. At Lake Village, Newton County, three nearly grown young and an adult female were taken in a meadow, July 31, 1930. The specimens are now in the Museum of Zoology, University of Michigan. August 25, 1930, while driving near Pulaski, Pulaski County, I saw a buzzard fly up from a small dark object in the road. It proved to be a badly mashed and much decomposed Franklin's Ground Squirrel. The same day near Monterey in the same county I saw one of these ground squirrels run across the road. Mr. C. C. Deam wrote me on June 15, 1931, that in company with and on the farm of Mr. George House, three miles northeast of Royal Center, Cass County, he had seen a Franklin's Ground Squirrel. Accompanied by my wife and Mr. William Engels, I visited the farm of Mr. House, on July 3, but neither he nor his neighbor, nor ourselves, could locate specimens or burrows. Mr. Deam's and Mr. House's description of the animal was so clear that there can be no doubt of its occurrence near Royal Center. West of Royal Center another farmer described the

animal to us and even showed us what appeared to be a burrow by the roadside, but a trap placed in it for about two hours yielded nothing. On July 4, we saw one standing by the roadside in southeastern Jasper County, but out of range of a small shot gun. About three weeks later we secured three specimens in an old field near North Liberty, St. Joseph County. Six steel traps were placed in burrows and in an hour's time three animals taken. These specimens are now at the University of Notre Dame, and so far as I know, constitute the most eastern record for the species. On Labor Day, 1931, my wife and I captured a specimen in a rockpile near a culvert in Wabash Township, Tippecanoe County. This is the most southern record of the species in Indiana. The specimen was given to the U. S. Biological Survey. At Monon Township, White County, I was told of a farmer who had found two in a state of hibernation under a haystack. He placed them in his warm car and by the time he reached home the ground squirrels had waked up and were rather lively. In Liberty Township, White County, a filling station agent said squirrels such as the one we had taken in Tippecanoe County were occasionally seen in the vicinity and that he had killed one like ours. Mr. Kenneth Johnson informs me that he saw three or four specimens of Franklin's Ground Squirrel in the south-east corner of Laporte County during the first week of May 1930. Mr. I. J. P. Schooley reports seeing a dozen of these ground squirrels in a cemetery one and a half miles north of Morocco, Newton County and has seen others near Fowler, Benton County.

The known distribution of Franklin's Ground Squirrels in Indiana, by counties, is shown on the accompanying map. M, indicates specimens in the University of Michigan; N, specimens in the United States National Museum; D, specimens in the University of Notre Dame; B, specimen in Blatchley's collection; P, published records not based on specimens in collections, including those reported for the first time in this article.

South Bend, Indiana.

Distribution of Franklin's Ground Squirrel in Indiana

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PLATE IV.

BOOK REVIEWS

LIMESTONES, THEIR ORIGINS, DISTRIBUTION AND USES, by F. J. North. London, Thomas Murby & Co.; New York, D. Van Nostrand, 1930. xxiv + 467 pp. $8.00.

SEDIMENTARY PETROGRAPHY, by Henry B. Milner. Second edition: London, Thomas Murby & Co.; New York, D. Van Nostrand, 1929. xxii + 514 pp. $8.50.

"There is scarcely a phase of modern life in which limestone does not play, directly or indirectly, a prominent part. In a country where there is no calcareous rock to determine the nature of the soil or to provide the means for its improvement, and no limestone that can be used for constructing its buildings, for making mortar and cement, for metallurgical processes, or in chemical industries, the progress of civilization must of necessity be slow and industrial developments unimportant; and the pre-eminence of our country [Great Britain] is to a large measure due to the abundance and wide distribution of a commodity that is not only indispensable in itself, but without which other natural resources could not be utilized to advantage."

This paragraph, from the closing chapter of Dr. North's *Limestones*, well might have appeared in its preface, for it gives the keynote of the book. Dr. North is not satisfied to treat limestones merely as results of sedimentation, as elements in topography, or as materials for manufacture; he unites these with a thorough understanding of the utilization of these rocks in the arts and crafts of the past as well as the present. The result is a volume which comes surprisingly near to a history of a selected part of the earth, and the cultures developed thereon, in terms of available calcareous sediments.

The device is novel—and its conclusions come with some surprise to those of us who have rather naively supposed that the history of civilization is one of increasing reliance upon iron and coal. We have simplified things too much, overlooking the fact that without limestone iron would be impossible in commercial amounts. As for the rest: even though one may not agree wholly with Dr. North upon the suitability of limestone as a building material to be combined with steel, he will not change matters much by stressing the desirability of cement or terra cotta. If not directly, then indirectly, calcareous rock retains its responsible position as one of the factors which have made civilizations possible.

So much for a thesis which seems revolutionary only because we have ignored the obvious. The book itself consists of eighteen chapters and

five appendices. Of these, three chapters deal with the nature, origin and varieties of limestones, with notes upon their geologic occurrence and their distribution in Great Britain. The following nine chapters amplify these last items, with geologic occurrence as the basis or organization, and attention limited to the British Isles. The result is a remarkably satisfying survey, which may be used most effectively in comparing the calcareous sediments of America (or any other region) with those of the region in which so many of our geologic divisions were first delimited and named. Frequent reference to stones used in building and decoration doubtless adds to the practical value of the book as a reference work.

Chapters XIII to XVIII deal with the relationships of limestones to scenery, agriculture, water supply and industry. Those pages devoted to scenery form an interesting footnote to physiography, as well as to human preferences in habitation and shelter; while those upon agriculture add materially to our understanding of this oldest of industries. Two chapters discuss limestone as a basis of architecture: one devoted to the use of stone as stone, and the other to the products which are derived from it, such as cement and concrete. Roads receive their share of attention, as do such minor users of limestone as the glass industries and chemical plants. The appendices set forth the classification of animals found fossil in limestones, and give brief notes upon analysis, output of limestones and derived products, and physical properties of selected British rocks.

Professor Milner's field is at once much broader and more limited than that surveyed by Dr. North. Instead of limestones alone, he confronts the whole vast array of sedimentary rocks; but by limiting himself to the criteria and methods of their petrographic study, he is able to avoid much that Dr. North must consider. Thus the two books differ widely in both scope an dpurpose, even while they share in their attention to sedimentary rocks, and the utilization of such rocks in both science and industry.

As a handbook of method, as well as for reference, *Sedimentary Petrography* is unusually comprehensive. There are chapters on the collection and storage of samples, the technique of laboratory analysis, microscopic examination, and the quantitative data which may be obtained thereby. Pages 116 to 263 are devoted to the diagnostic properties of minerals in sedimentary rocks, with abundant illustrations on well-printed plates, while almost forty pages more are given to the petrography of consolidated sediments, and twenty to the petrology of soils and related superficial deposits.

To the paleontologist and stratigrapher, the most interesting chapters are those numbered VIII to X, which deal with correlation by petrographic methods and the bearing of sedimentary petrography upon paleogeographic problems. To the evolutionist, especially, correlation and paleogeography present annoying problems, since our familiar pro-

cedure in the former is apt to distort or obscure time relationships than it is to reveal them, while much detailed paleogeopraphy reconstructs environments by methods which come dangerously near to working in circles. It is not clear that petrography will aid much in the former difficulty, but it seems that the indicator-minerals whose significances Mr. Milner outlines may be of no little value in checking data as to geologic environments. At the very least, they represent the environment itself, not the responses of organisms which dwelt within it, and to that extent furnish data which are independent of the faults and virtues of inferential paleontology.—Carroll Lane Fenton.

THOMAS SAY, EARLY AMERICAN NATURALIST, by Harry B. Weiss and Grace M. Ziegler. Springfield, Ill., Charles C. Thomas. xiv + 260 pp., $5.00.

Thomas Say was the chief American pioneer in entomology, published the first American descriptions of invertebrate fossils, and was an intimate friend of most of the naturalists who worked in the United States during the early third of the nineteenth century. His associations as well as his accomplishments therefore form an important chapter in the natural history of this continent.

Say was born in Philadelphia on June 27, 1787, dying in New Harmony, Indiana, on October 10, 1834. His education was the simplest, as records of the school which he attended show; and perusal of the letters reprinted by the present authors bear out the oft-made criticism that his command of English was poor. Yet in spite of these hindrances, plus those of comparative isolation, poverty and business cares, his achievements are among the most striking of his generation. Despite our present official hostility to the amateur, Say's lack of a degree and a professorship seems not to have hampered his work.

It is upon his life and associations, however, which this biography concentrates. Enough probably has been published about Say's scientific influence; and in these days of standardization it is well for us to be reminded that the successful scientist was not always an educator or an official, skilled in the art of voicing agreement, and adept in the phrase-making of System and Education. The devoted zoologist who fills these pages would have been sadly out of place at a sorority tea, and as unhappy in the wranglings of a curriculum committee as he was in the business operations of his friend Maclure.

The technical execution of this biography leaves little to be desired. The authors do not presume to speak for their character; they place him in the setting of his time, and allow Say to do the rest. In the process, they discover much that previous biographers have not published and thus add materially to our information of a heroic period of American science.—C. L. F.

NOTE

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